

CLAIMS

What is claimed is:

- 1 1. A method comprising:
2 manufacturing a resonator beam having a first end and a second end, said resonator
3 beam suspended above a substrate by said first end and said second end, said resonator beam
4 having a first end connected to an actuator; and
5 using said actuator to applying an actuation force to resonator beam to apply strain
6 onto said resonator beam.
- 1 2. The method of Claim 1 wherein said actuator is a comb structure.
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- 1 3. The method of Claim 1 wherein said actuator is a ratchet wheel.
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- 1 4. The method of Claim 1 wherein said actuator is a ratchet wedge.
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- 1 5. The method of Claim 1 wherein said actuator is a large coefficient of thermal
2 expansion heater.
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- 1 6. The method of Claim 1 wherein said actuator is a ratcheting shaft.
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- 1 7. The method of Claim 1 wherein said actuator is connected to said resonator beam
2 through a lever arm, said lever arm receiving said actuation force from said actuator and

transmitting said actuation force applied by said actuator proportionally to said resonator beam.

8. The method of Claim 7 wherein said actuation force supplied by said actuator is proportional to a temperature.

9. The method of Claim 8 wherein a tensile strain is applied to said resonator beam as said temperature increases.

10. The method of Claim 8 wherein a compressive strain is applied to said resonator beam as said temperature increases.

11. The method of Claim 7 wherein said actuator is a comb structure acting on said lever arm.

12. The method of Claim 7 wherein said actuator is a ratchet wheel that engages said lever arm.

13. The method of Claim 7 wherein said actuator is a ratchet wedge that acts on said lever arm.

1 14. The method of Claim 7 wherein said actuator is a large coefficient of thermal
2 expansion heater acting on said lever arm.

1 15. The method of Claim 7 wherein said actuator is a ratchet shaft acting on said lever
2 arm.

1 16. The method of Claim 11 wherein said comb structure exerts force on a curved beam
2 that in turn transmits force onto said lever arm.

1 17. The method of Claim 8 further comprising connecting said second end of said
2 resonator beam to a second lever arm and using said second lever arm in concert with said
3 first lever arm to apply a strain to said resonator beam.

1 18. The method of Claim 17 wherein said actuator applies said actuation force to both
2 said lever arm and said second lever arm.

1 19. The method of Claim 17 wherein said lever arm and said second lever arm rotate
2 about a pivot point so as to proportionally modify the amount of strain applied to said
3 resonator beam.

1 20. The method of Claim 7 wherein said actuator is an expansion bar that provides said
2 actuation force proportional to a temperature.

1 21. An apparatus comprising:
2 a resonator beam having a first end and a second end, said resonator beam suspended
3 above a substrate by said first end and said second end; and
4 an actuator connected to said first end of said resonator beam, said actuator applying
5 an actuation force to said resonator beam to apply strain onto said resonator beam.

1 22. The apparatus of Claim 21 wherein said actuator is a comb structure.
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1 23. The apparatus of Claim 21 wherein said actuator is a ratchet wheel.
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1 24. The apparatus of Claim 21 wherein said actuator is a ratchet wedge.
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1 25. The apparatus of Claim 21 wherein said actuator is a large coefficient of thermal
2 expansion heater.
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1 26. The apparatus of Claim 21 wherein said actuator is a ratcheting shaft.
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1 27. The apparatus of Claim 21 further comprising a lever arm, said actuator connected to
2 said resonator beam through said lever arm, said lever arm receiving said actuation force
3 from said actuator and transmitting said actuation force applied by said actuator
4 proportionally to said resonator beam.
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1 28. The apparatus of Claim 27 wherein said actuation force supplied by said actuator is
2 proportional to a temperature.

1 29. The apparatus of Claim 28 wherein a tensile strain is applied to said resonator beam
2 as said temperature increases.

1 30. The apparatus of Claim 28 wherein a compressive strain is applied to said resonator
2 beam as said temperature increases.

1 31. The apparatus of Claim 27 wherein said actuator is a comb structure acting on said
2 lever arm.

1 32. The apparatus of Claim 27 wherein said actuator is a ratchet wheel that engages said
2 lever arm.

1 33. The apparatus of Claim 27 wherein said actuator is a ratchet wedge that acts on said
2 lever arm.

1 34. The apparatus of Claim 27 wherein said actuator is a large coefficient of thermal
2 expansion heater acting on said lever arm.

1 35. The apparatus of Claim 27 wherein said actuator is a ratchet shaft acting on said lever
2 arm.

1 36. The apparatus of Claim 31 wherein said comb structure exerts force on a curved beam
2 that in turn transmits force onto said lever arm.

1 37. The apparatus of Claim 28 further comprising a second lever arm connected to said
2 second end of said resonator beam and using said second lever arm in concert with said first
3 lever arm to apply a strain to said resonator beam.

1 38. The apparatus of Claim 37 wherein said actuator applies said actuation force to both
2 said lever arm and said second lever arm.

1 39. The apparatus method of Claim 37 wherein said lever arm and said second lever arm
2 rotate about a pivot point so as to proportionally modify the amount of strain applied to said
3 resonator beam.

1 40. The method of Claim 37 wherein said actuator is an expansion bar that provides said
2 actuation force proportional to a temperature.

1 41. A temperature compensated resonator comprising:

2 a resonator beam having a first end and a second end, said resonator beam suspended
3 above a substrate by said first end and said second end; and

4 an actuator connected to said first end of said resonator beam, said actuator applying
5 an actuation force to said resonator beam to apply a tensile strain onto said resonator beam,
6 said actuation force dependent upon a temperature.

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1 42. The apparatus of Claim 41 wherein said actuator is an expansion bar.

1 43. The apparatus of Claim 41 further comprising a lever arm, said actuator connected to
2 said resonator beam through said lever arm, said lever arm receiving said actuation force
3 from said actuator and transmitting said actuation force applied by said actuator
4 proportionally to said resonator beam.

1 44. The apparatus of Claim 43 wherein said actuator is an expansion bar acting on said
2 lever arm.

1 45. The apparatus of Claim 43 further comprising a second lever arm connected to said
2 second end of said resonator beam and using said second lever arm in concert with said first
3 lever arm to apply said tensile strain to said resonator beam.

1 46. The apparatus of Claim 45 wherein said actuator applies said actuation force to both
2 said lever arm and said second lever arm.

1 47. The apparatus method of Claim 46 wherein said lever arm and said second lever arm
2 rotate about a pivot point so as to proportionally modify the amount of tensile strain applied
3 to said resonator beam.

1 48. A temperature sensor comprising:
2 a resonator beam having a first end and a second end, said resonator beam suspended
3 above a substrate by said first end and said second end; and
4 an actuator connected to said first end of said resonator beam, said actuator applying
5 an actuation force to said resonator beam to apply a compressive strain onto said resonator
6 beam, said actuation force dependent upon a temperature.

1 49. The apparatus of Claim 48 wherein said actuator is an expansion bar.

1 50. The apparatus of Claim 48 further comprising a lever arm, said actuator connected to
2 said resonator beam through said lever arm, said lever arm receiving said actuation force
3 from said actuator and transmitting said actuation force applied by said actuator
4 proportionally to said resonator beam.

1 51. The apparatus of Claim 50 wherein said actuator is an expansion bar acting on said
2 lever arm.

1 52. The apparatus of Claim 50 further comprising a second lever arm connected to said
2 second end of said resonator beam and using said second lever arm in concert with said first
3 lever arm to apply said tensile strain to said resonator beam.

1 53. The apparatus of Claim 51 wherein said actuator applies said actuation force to both
2 said lever arm and said second lever arm.

1 54. The apparatus method of Claim 53 wherein said lever arm and said second lever arm
2 rotate about a pivot point so as to proportionally modify the amount of tensile strain applied
3 to said resonator beam.